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Decreased severity of disease during the first global omicron variant covid-19 outbreak in a large hospital in tshwane, south africa

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HIGHLIGHTS

- the rapid rise and decline of admissions and decreased severity of COVID-19 disease
- compares 466 patients to 3976 patients in previous waves
- describes disease severity of all admitted patients at peak bed occupancy
- a lower mortality rate from Omicron compared to previous waves

DECREASED SEVERITY OF DISEASE DURING THE FIRST GLOBAL OMICRON VARIANT COVID-19 OUTBREAK IN A LARGE HOSPITAL IN TSHWANE, SOUTH AFRICA

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ABSTRACT

INTRODUCTION

The coronavirus disease 2019 (COVID-19) first reported in Wuhan China in December 2019 is a global pandemic that is threatening the health and wellbeing of people worldwide. To date there have been more than 274 million reported cases and 5.3 million deaths. The Omicron variant first documented in the City of Tshwane, Gauteng Province, South Africa on 9 November 2021 led to exponential increases in cases and a sharp rise in hospital admissions. The clinical profile of patients admitted at a large hospital in Tshwane is compared with previous waves.

METHODS

466 hospital COVID-19 admissions since 14 November 2021 were compared to 3976 prior admissions since 4 May 2020. Ninety-eight patient records at peak bed occupancy during the outbreak were reviewed for primary indication for admission, clinical severity, oxygen supplementation level, vaccination and prior COVID-19 infection. Provincial and city-wide daily cases and reported deaths hospitalizations and excess deaths data were sourced from the NICD, the National Department of Health and the South African Medical Research Council.

RESULTS

Deaths and ICU admissions were 4.5% vs 21.3% ($p<0.00001$), and 1% vs 4.3% ($p<0.00001$); length of stay was 4.0 days vs 8.8 days; and mean age was 39 years vs 49 years for the Omicron and previous waves respectively.

Admissions peaked and declined rapidly with peak bed occupancy at 51% of highest previous peak.

Sixty two (63%) patients in COVID-19 wards had incidental COVID-19 following a positive SARS-CoV-2 PCR test. Only one third (36) had COVID-19 pneumonia, of which 72% had mild to moderate disease. The remaining 38% required high care or ICU admission. Fewer than half (45%) of patients in COVID-19 wards compared to 99.5% in the first wave required oxygen supplementation.

City and provincial rates show decoupling of cases, hospitalisations and deaths compared to previous waves, corroborating the clinical findings of milder omicron disease in the hospital.

CONCLUSION

There was decreased severity of disease in the Omicron driven fourth wave in the City of Tshwane, its first global epicentre.

INTRODUCTION

The coronavirus disease 2019 (COVID-19) first reported in Wuhan China in December 2019 is a global pandemic that is threatening the health and wellbeing of people worldwide. To date there have been

more than 274 million reported cases and 5.3 million deaths. South Africa has borne the brunt of COVID-19 on the African continent registering in excess of 3 million cases and 90 000 officially reported deaths. The number of deaths could be as high as 275,976, putting this country's death toll among the highest in the world with a cumulative excess death rate of 464 per 100,000. South Africa is currently experiencing its fourth COVID-19 wave being driven by the recently identified Omicron variant. Previous waves were associated with the Ancestral, Beta and Delta Variants.

The City of Tshwane (incorporating Pretoria and surrounding areas just north of Johannesburg), with its population of 3.31 million people has had 241,794 cases of SARS-CoV-2, 35 090 hospital admissions and 7,086 deaths since the first COVID-19 admission at the Steve Biko Academic Hospital on 4 May 2020. The first case of Omicron was documented in the City of Tshwane on 9 November 2021. This was followed by a rapid rise in SARS-CoV-2 infections and COVID-19 associated hospitalisations since 14 November 2021, heralding the onset of the fourth wave in South Africa.

During the resurgence in Tshwane, we noticed a difference in the clinical picture of COVID-19 ward patients compared with prior COVID-19 waves. We report from the first global epicentre of Omicron driven resurgence on the patient profile of admissions to the Steve Biko Academic Hospital Complex in Pretoria, the heart of the Tshwane District. The hospital has a COVID-19 bed capacity of 220 beds. In the current study, we compare 466 COVID-19 admissions in the first 33 days since the commencement of the Omicron driven fourth wave with a total of 3976 admissions over the previous 18 months and 3 pandemic waves since May 2020 and provide a description of the clinical profile of 98 patients in the hospital at the peak of the Omicron wave on 14-15 December 2021.

METHODS

The Steve Biko Academic Hospital Complex (SBAH) incorporates the Steve Biko Academic Hospital which is an 800 bed tertiary academic hospital to which is attached the University of Pretoria's Health Sciences Faculty and the Tshwane District Hospital which is a 240-bed district hospital on the grounds of the tertiary facility. The latter facility was converted into the COVID-19 section of the complex and included general, paediatric, high care and ICU wards. The hospital complex also had designated COVID-19 theatres, labour wards and emergency units. All specialties provided services in the designated COVID-19 wards.

At the beginning of the pandemic in March 2021, a national hospital admissions surveillance system (DATCOV) was established by the National Institute of Communicable Diseases (NICD). Hospital level data from the Hospital Complex were extracted from the COVID-19 hospital surveillance system for patients admitted to the Steve Biko Academic Hospital Complex (SBAH) from 4 May 2020 through 16 December 2021. These hospital records were reviewed for a comparison between patients admitted during the Omicron wave and previous waves. All patients were included in the sample.

466 records from DATCOV of patients admitted during the Omicron Wave were compared to all 3976 records of patients admitted during three previous waves over a period of 18 months. In addition, a snapshot analysis of 98 records of patients occupying COVID-19 beds in the hospital at peak bed occupancy were reviewed for severity of illness, primary indication for admission, oxygen

supplementation level and self-reported vaccination and prior COVID-19 infection status. These data were entered onto the internal hospital information system. Oxygen supplementation levels for 588 patients admitted to the hospital during the first wave were reviewed from the same hospital information system from an analysis performed by the hospital COVID-19 outbreak team.

The record files of 21 deceased patients for the period 14 November through 16 December were requested from the hospital registries and reviewed for cause of death.

Hospital COVID-19 bed occupancy was obtained from daily statistics captured by the Nursing Services Manager responsible for bed management at the facility.

Data for the number of cases and admissions for the Tshwane District were extracted from the weekly surveillance report published by the NICD.

Case and mortality data from the South African national coronavirus database established by the National Department of Health (<https://sacoronavirus.co.za/>) was used for the City of Tshwane and the Gauteng Province as a whole.

Data for the district and province wide cases, deaths and hospital admissions were provided by the National Institute of Communicable Diseases. Data analysis was done using Excel and STATA 16. Data smoothing was performed using LOWESS in STATA 16.

RESULTS

An exponential increase in SARS-CoV-2 infections was reported in the Tshwane district of Gauteng Province commencing in the week of 7 November 2021. The NICD reported an exponential increase in SARS-CoV-2 infections recorded in both the public and private sector laboratories in the Tshwane District commencing in the week of 7 November 2021 as shown in Figure 1 reaching 11 010 cases in the week of 28 November 2021 and peaking in the week of 5 December 2021.

The highest occupancy of COVID beds during the Omicron wave was 108 on 13 December 2021, much lower than the highest level of COVID bed occupancy over previous waves which was 213 beds occupied on 13 July 2021 at the peak of the Delta Wave.

There was a concomitant increase in admissions at the hospital complex with 466 admissions to the COVID-19 wards between 14 November and 16 December 2021 compared to 20 admissions in the preceding two weeks (Figure 2).

Table 1 compares 466 patients admitted during the Omicron wave and 3976 during previous waves, showing significant differences in the age distribution, outcomes, level of care required, and length of hospital stay. Mean age was significantly lower (39 vs 49.8 years), most admissions were in the 30 – 39 year age group, 68% of admissions were for those below 50 compared to 46% previously, and the proportion of admissions in 0-9 year olds doubled.

There were 21 (4.5%) compared to 847 (21.3%) in-hospital deaths, and 5 (1%) ICU admissions compared to 172 (4.3%) in previous waves. Length of stay was significantly shorter across all age groups.

A cause of death analysis for 21 deceased patients in the Omicron wave at the hospital showed COVID-19 with a confirmed COVID pneumonia as the cause of death in 10 (48%) patients, another cause exacerbated by COVID pneumonia in 4 (19%), and a cause unrelated to COVID pneumonia in 7 (33%).

The highest number of COVID beds occupied during the Omicron Wave was 108 on 13 December 2021, much lower than the highest level of COVID bed occupancy over previous waves which was 213 beds occupied on 13 July 2021 at the peak of the Delta Wave.

Figure 3 and Table 2 show clinical severity of 98 patients in the COVID wards on 14-15 December 2021.

Thirty-six (37%) had a confirmed diagnosis of COVID pneumonia, of which 31(86%) required oxygen supplementation.

Sixty-two (63%) patients were incidental COVID admissions having been admitted for another serious primary medical, surgical, obstetric or psychiatric diagnosis. These cases have been labelled 'incidental COVID' as they were diagnosed as the result of hospital admission procedures, rather than having the typical clinical profile or meeting a case definition for COVID-19. This phenomenon of 'incidental COVID' is not a phenomenon observed before in South Africa and most likely reflects high levels of asymptomatic disease in the community with Omicron infection. As all patients being admitted to the hospital are tested for SARS-CoV-2 as per the policy, those testing positive are admitted to the designated COVID wards.

Fifty-four patients (55%) coped on room air without supplemental oxygen.

Table 2 shows the level of oxygen supplementation as an index of severity among patients with COVID-19 pneumonia of whom 26 (72%) required no or low levels of oxygen supplementation. Ten (10) patients (28%) required high care or ICU admission. Among the 4 ICU admissions, 3 patients exhibited features of a COVID-19 pneumonia, however only 1 patient required invasive mechanical ventilation primarily for COVID-19 associated respiratory failure. One (1) patient required invasive mechanical ventilation for confirmed pneumonia with severe COPD and cardiogenic shock in the Emergency Care Unit. The six paediatric admissions to paediatric high care/ICU were attributed to diagnoses unrelated to COVID-19.

The Emergency Medical Unit in the SBAH complex noticed a marked decline in the use of oxygen tank compared with previous waves.

Fifty-five pregnant women were admitted to the COVID-19 labour ward from 1 to 16 December 2021. Among the 2 two women admitted to the labour ward requiring face-mask oxygen, one patient had a

mild COVID-19 pneumonia and required supplemental oxygen for 3 days another diagnosis. Peak bed occupancy (18) in the labour ward was on 10 December and declined (8) by 14 December 2021.

The findings described above for the Steve Biko Academic Hospital Complex were comparable to city-wide trends when cases and admissions from all public and private hospital reported in the national hospital surveillance system. The data from the NICD DATCOV database showed that, early in the fourth wave from 14 November to 16 December 2021, a total of 33,643 SARS-CoV-2 cases, 3,233 COVID-19 hospitalisations and 130 deaths were reported in the City of Tshwane reflecting a lower admission per case ratio, lower death rate and lower rates of admission to the ICU compared to previous waves.

Figure 4 further shows an uncoupling of the case and death rates for the Gauteng Province as a whole, confirming the local hospital experience of significantly fewer admissions to the ICU and deaths compared to previous waves and the city-wide trends.

DISCUSSION

The Omicron outbreak has spread and declined in the City of Tshwane with unprecedented speed peaking within 4 weeks of its commencement. Hospital admissions increased rapidly and began to decline within a period of 33 days.

Peak bed occupancy was about half that of the third (Delta) wave. The patient age distribution was younger than before, with fewer ICU admissions and deaths and a shorter length of stay. A third of deaths resulted from a cause other than COVID-19, and there were no paediatric deaths or ICU admissions related to severe COVID-19 disease. Sixty three percent of COVID-19 patients in the snapshot at peak bed occupancy in the week of 11 December 2021, were in hospital for an alternative primary diagnosis, and were 'incidental COVID' patients as they were diagnosed as the result of hospital admission procedures, rather than having the typical clinical profile or meeting a case definition for COVID. This phenomenon has not been observed to this extent before in the Steve Biko Academic Hospital Complex of anywhere in South Africa and most likely reflects high levels of asymptomatic disease in the community with Omicron infection.

The low percentage of patients in the COVID-19 wards with a confirmed diagnosis of COVID-19 pneumonia has implications for the application of clinical skill and discipline of expertise being deployed to the COVID-19 wards with all specialties required to manage their 'incidental COVID patients under COVID-19 infection control standards. It also implies much lower oxygen utilization levels in the COVID-19 wards. The categorization of patients into 'incidental SARS-CoV-2' and moderate to severe COVID-19 disease may lead to a radically different internal organization of COVID-19 wards at the hospital complex to increase the more efficient level of skills and expertise to the different categories including nursing and allied professionals and the management of equipment inventories used for patients with moderate to severe COVID-19 disease.

A similar profile of patients is being seen in COVID-19 wards in the Western Cape Province of South Africa and anecdotal reports of similar patterns have described by one of South Africa's largest private hospital groups.

The changing clinical presentation of SARS-CoV-2 infection is likely due to high levels of prior infection and vaccination coverage. The estimated seroprevalence of hybrid immunity (immunity from prior infection and vaccine induced immunity) for the City of Tshwane is 66.7% (95% CI, 54.2 to 69.0). About 36% of adults aged 18 to 49 and 58% over age 50 in the Gauteng Province are vaccinated. Another plausible cause for the lower number of admissions and decreased severity is a decrease in pathogenicity of the highly mutated Omicron variant, though more research is required to support this theory.

A similar pattern is likely emerge in other provinces in South Africa as Omicron spreads rapidly across the country, but may differ in countries where levels of hybrid immunity and the mix of natural immunity from prior infection and vaccination are different.

Limitations of the include the inability of the analysis to compare the Omicron Wave to each of the three previous waves separately due to the difficulty of defining the beginning and end dates of previous waves. Another limitation of the study is that it was unable to compare clinical parameters of patients in the COVID-19 wards across waves due to poor electronic record keeping of these parameters including clinician evaluations, chest-xray finding and blood biomarkers for COVID-19 disease.

CONCLUSION

There was decreased severity of disease in the Omicron driven fourth wave in the City of Tshwane, its first global epicentre, with fewer deaths, ICU admissions and a shorter length of stay. The younger age profile of patients is likely to have been a factor of this clinical profile.

The wave increased at a faster rate than previous waves, completely displacing the Delta variant within weeks and began its decline in both cases and hospital admissions in the fifth week following its commencement.

There are clear signs that case and admission rates in South-Africa may decline further over the next few weeks. If this pattern continues and is repeated globally, we are likely to see a complete decoupling of case and death rates suggesting that Omicron may be a harbinger of the end of the epidemic phase of the Covid pandemic ushering in its endemic phase.

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Ethics Approval

Ethics approval was granted by the University of the Witwatersrand (DATCOV MED2010093) and the University of Pretoria's Research Ethics Committee (637/2020).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

- Boswell T et al. COVID-19 severity and in-hospital mortality in an area with high HIV prevalence, 09 December 2021, PREPRINT (Version 1) available at Research Square [<https://doi.org/10.21203/rs.3.rs-1156502/v1>]
- Bradshaw D et al. Estimated natural deaths of persons 1+years. South Africa Medical Research Council. <https://www.samrc.ac.za/reports/report-weekly-deaths-south-africa> (accessed 20 December 2021)
- Madhi Shabir A, et al. South African Population Immunity and Severe Covid-19 with Omicron Variant. Shabir A. Madhi, et al, <https://www.medrxiv.org/content/10.1101/2021.12.20.21268096v1>
- Mendelsohn Ase t al. COVID-19 wave 4 in Western Cape Province, South Africa: Fewer hospitalisations, but new challenges for a depleted workforce. S Afr Med J. Published online 21 December 2021. <https://doi.org/10.7196/SAMJ.2022.v112i2.16348>
- National Department of Health. COVID-19 statistics in South Africa. <https://sacoronavirus.co.za/> (accessed 11 December 2021)
- National Institute for Communicable Diseases. <https://www.nicd.ac.za/wp-content/uploads/2021/12/COVID-19-Weekly-Epidemiology-Brief-week-48-2021.pdf>. COVID-19 Wkly. Epidemiol. BRIEF, WEEK 48 2021. <https://www.nicd.ac.za/wp-content/uploads/2021/12/COVID-19-Weekly-Epidemiology-Brief-week-48-2021.pdf> (accessed 20 December 2021).
- Network for Genomics Surveillance in South Africa (NGS-SA). SARS-CoV-2 Genomic Surveillance Update. https://www.nicd.ac.za/wp-content/uploads/2021/12/Update-of-SA-sequencing-data-from-GISAID-17-Dec-21_Final.pdf (accessed 20 December 2021).
- Office of the Executive Mayor <https://www.tshwane.gov.za/sites/Council/Office-Of-The-Executive-Mayor/20162017%20IDP/01.%20Tabling%20of%20the%20City%20of%20Tshwane%202021%202026%20IDP.pdf> (accessed 20 December 2021)
- Stata/IC 16.1 for Mac Revision 31 Mar 2020 <https://www.stata.com/products/mac/> (accessed 23 December 2021)
- Viana R et al. Rapid epidemic expansion of the SARS-CoV-2 Omicron variant in southern Africa. medRxiv, MEDRXIV-2021-268028v1-deOliveira: (2021).
- World Health Organisation. <https://covid19.who.int/> (accessed 22 December 2021).
- World Health Organization. Classification of Omicron (B.1.1.529): SARS-CoV-2 Variant of Concern. [https://www.who.int/news/item/26-11-2021-classification-of-omicron-\(b.1.1.529\)-sars-cov-2-variant-of-concern](https://www.who.int/news/item/26-11-2021-classification-of-omicron-(b.1.1.529)-sars-cov-2-variant-of-concern) (accessed Dec 10, 2021)

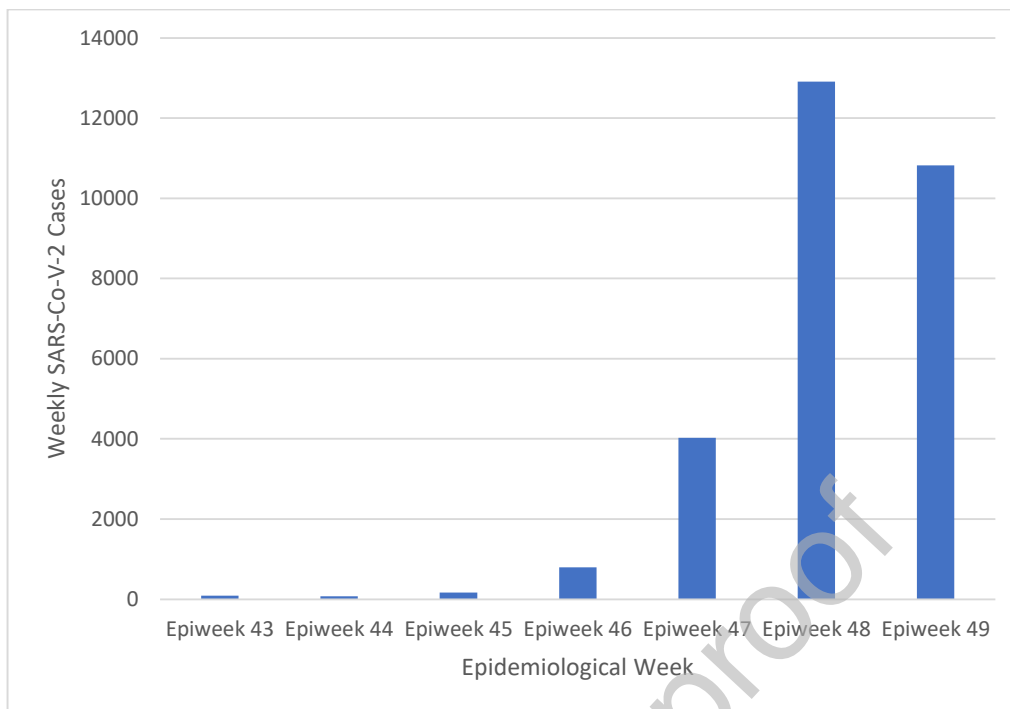


Figure 1. Weekly number of SARS-CoV-2 cases in Tshwane District, 24 October through 11 December 2021 (NICD)

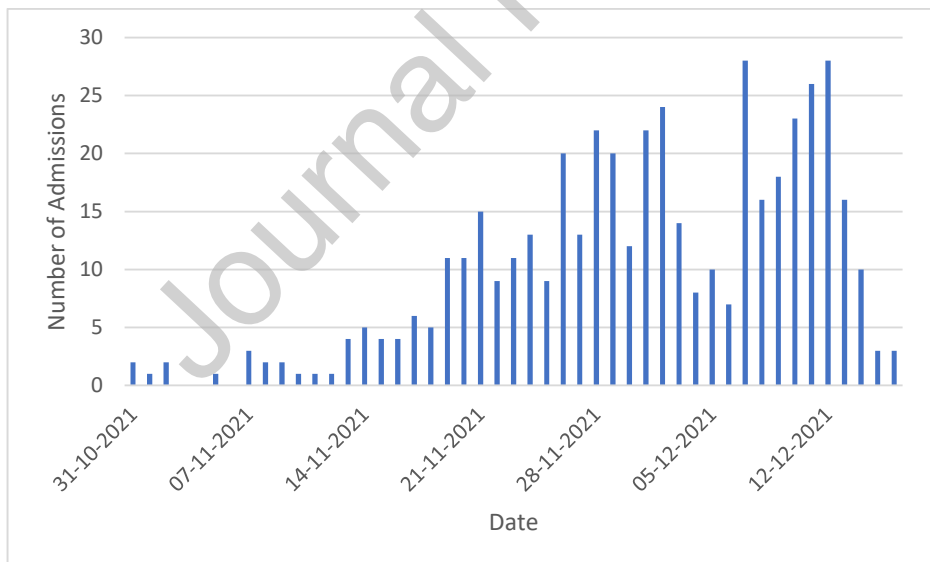


Figure 2. Daily number of COVID-19 hospital admissions for Steve Biko Academic Hospital Complex, 31 October to 16 December 2021

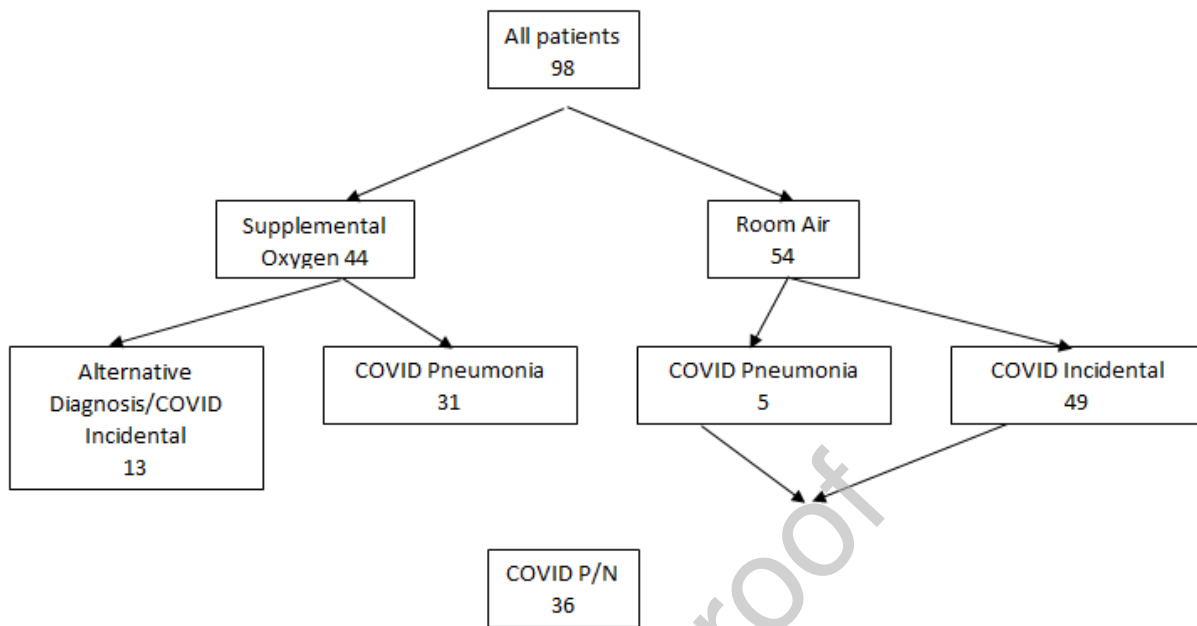


Figure 3. Tree diagram showing severity status of admissions at Steve Biko Academic Hospital Complex on 14-15 December 2021

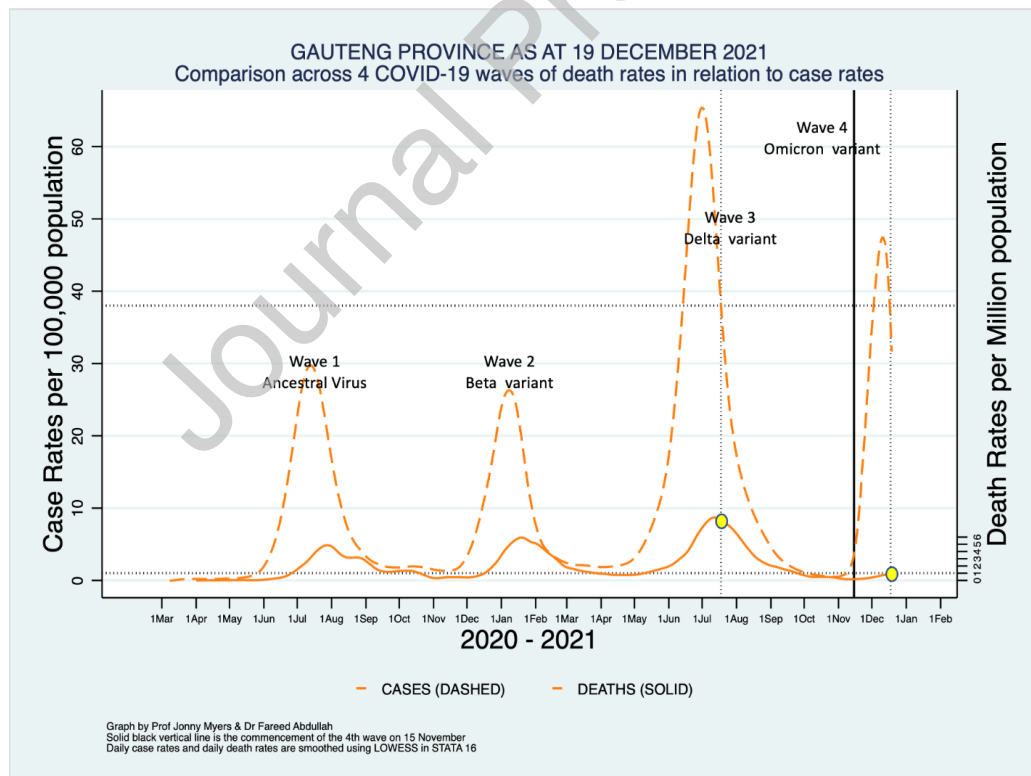


Figure 4 : COVID-19 cases and reported deaths rates for Gauteng

Table 1: Description of COVID-19 admissions at Steve Biko Academic Hospital Complex, fourth wave compared to previous waves

INDICATORS	14/11/21 – 16/12/21	4/5/2020- 13/11/21	TEST PARAMETER	SIGNIFICANCE LEVEL
	n(%) or mean(SD)	n(%) or mean(SD)		
# Admissions	466	3976		
Mean age	39(22.4)	49.8(21.8)	t= - 10.2	p< 0.00001
Proportions in age groups				
0-9	60(12.9)	272(6.9)	z= 5.1	p< 0.00001
10-19	17(3.7)	91(2.2)	z = 2	P = 0.044
20-29	83(17.8)	255(6.4)	z=8.8	p< 0.00001
30-39	105(22.5)	551(13.9)	z=5.1	p< 0.00001
40-49	46(9.8)	518(13.1)	z= - 1.9	p = 0.15
<=50	316(67.8)	1834(46.1)	Z=8.9	p< 0.00001
>=50	150(32.2)	2142(53.9)	Z=-8.9	p< 0.00001
50-59	33(7.1)	669(17)	z = -5.5	p< 0.00001
60-69	64(13.7)	753(19)	z= -2.7	P = 0.0061
70+	41(8.8)	645(16.3)	z= -5.1	p< 0.00001
Length of stay	4.0(SD3.7)	8.8(19)	t = - 5.4	p< 0.00001
ICU	5(1%)	172(4.3%)	z= -3.4	P 0.0007
Deaths	21(4.5%)	847(21.3%)	z= - 8.7	P< 0.00001

Table 2. Levels of oxygen supplementation for COVID pneumonia patients at Steve Biko Academic Hospital Complex 14-15 December 2021

Oxygen Supplementation Modality	Room Air	Nasal Prongs Oxygen	Face Mask Oxygen	Double Oxygen Nasal Prongs+ Face Mask Oxygen	High Flow Nasal Oxygen	Non Invasive Ventilation	Mechanical Ventilation	TOTAL
Confirmed COVID Pneumonia	5 (14%)	13 (36%)	8 (22%)	1(3%)	1 (3%)	4 (11%)	4 (11%)	36 (100%)